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THE ROLE OF THE FLOOD AREA AND SLOPES OF DAM OF THE RIVER TISZA IN FEEDING WILD BEES

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Abstract

In the spring aspect the foster-plant spectrum is provided by the species of the *Potentilla genus* plant family at the flood areas, and by the species of the *Labiatae*, *Papilionaceae* and *Cruciferae* plant families at the slopes of the dam.

In summer the most significant pollen- and nectar-producing plants in Hungary are the species of the *Cruciferae*, *Boraginaceae*, *Papilionaceae*, *Compositae* and *Lythraceae* plant families.

In autumn the nectar-production gradually ceases and the amount of pollens decraeses.

At the areas examined by us the flowery meadow-plant and weed species-combination is the most varied in the biotopes of the Upper-Tisza. The nectar- and pollen-production at the area is significantly supplied by the resowing of the papilionaceous agrocultures.

On the basis of our studies the nectar-production of the *Symphytum officinale*, *Salvia nemorosa* and the *Echium vulgare* is the most important from wild apicultural point of view.

The bee pasture-land of the flood area and the slope of the dam is more significant for the wild bees than from the viewpoint of the honey-bees.

Key words: Tisza–embankment, flood area, nectar, wild bees.

Introduction

The significance of the nature-close plant-associations has increased with the repression of the ruderal areas from the viewpoint of the feeding, nesting and brood-tendance of the wild bees. Through their flowering plants, the flood area and dam-system — generally not exposed to anthropogenic effects with the exception of mowing — ensure continuous pollen- and nectar-source for the wild bee populations. As pasture-land this area is perhaps more important for the wild bees, than from apicultural point of view. The dam sides of the rivers are practically exempt from the use of chemicals, thus they have resulted the enrichment of the economically also significant, entogamic wild bee species. The agricultural significance of these wild bees in our country has been studied in detail at various regions of Hungary by BÖJTÖS (1956), BENEDEK (1977), BENEDEK et al. (1971, 1973, 1975, 1977) and TANÁCS (1974, 1977), through the pioneer works of L. MÓCZÁR (1956, 1959a, 1959b, 1961a, 1961b). The flower-structure of several meadow-, weed and crop plants hinders autogamy in our country, too (KNUTH, 1899, TROLL, 1967, FREE, 1970). Thus, the role of wild bees in the entogamic pollination of the plants is

essential. This is especially important in the case of the wild bee populations swarming from the flood area and slope of dam — as bee pasture-lands — to the atrocultures of the back areas.

Besides the entomological researches, one of the aims of our investigations was to determine the meadow-plant and weed species-spectrum serving as energy source for the wild bee populations in the given terrestrial ecosystem, and further, to estimate the production of the more significant plant species producing nectar and pollen.

Study areas, material and methods

The study areas were the relatively nature-close grasslands of the flood area and slope of dam on the water- and protected sides of the dam-system at the Hungarian section of the Tisza river between Tiszasziget and Tarpa (165 and 712 riv.km). Alongside the 586,4 km long section of the river the area of the water-side slope of dam and the flood area was 83515 ha, from which 19873 ha, 24% was forest, 6350 ha, 8% was orchard, 57292 ha, 68% was plough land, pasture and meadow (BIRÓ, 1984). The slope of dam on the protected side and the back areas not exposed directly to angroculture were 4350 ha large. The studied section was divided into 3 subareas: Lower-Tisza (L-T), Middle-Tisza (M-T) and Upper-Tisza (U-T) which will be mentioned hereinafter in abbreviated forms.

The surveying sites of the L-T. terrestrial ecosystem were Tiszasziget, Szeged, Körtvélyes-Mártély, Körtvélyes-sziget, Szandaszőlős, Röszke, Algyő, Csongrád, Csongrád-Bokros, Alpári-meadow, Lakitelek-Tőserdő. A total of 113 recordings were performed.

The surveying-sites at the M-T. were Kisköre, Tiszanána, Sarud, Poroszló, Tiszavalk, Abádszalók, Tiszaderzs, Tiszaszőlős, Tiszafüred-Tiszaörvény, Tiszacsege. The number of study days was 41.

The surveying-sites at the U-T. were divided into zones. Tokaj 1. zone: area directly in front of the settlement, the species-combination of the phytocenosis here differed in some respects from the species-composition of the plant-association formed at the dams. Tokaj 2. zone: this area was at a distance of 2 km south of Tokaj. Further surveying-sites at the U-T. were Jánd, Gulács, Tivadar and Tarpa. The number of study days was 37.

The total number of study days was 191 at the three dam-sections, but amounted to 203 together with recordings of other nature.

Recordings were made on 10-10 occassions, within a total of 2 x 500 m^2/60 min. at the water- and protected sides of the slopes, of dam proceeding in traced form in the level heights of the dam-side, and adapting to the phytocenoses. The recordings at the flood areas were performed at an area of 20 x 50 m^2. The zone-recordings lasted from March till the beginning of October, in compliance with the various aspects. During the course of the observations the coverage of the flowering meadow-plants and weeds was determined, related to area units. Throughout the studies, the flower-visiting sphere as well as the nectar- and pollen-collecting activity of the various wild bees were observed. During the course of the entomological recordings the wild bees collected on flowers were later identified, provided with appropriate data.

Studies on nectar-production were also carried out on the most important foster-plants flowering at the flood areas and dam-sides. 24 hours prior to the study the plants were covered with 2 mm meshed net. The nectar was collected with the help of the glass-capillary method (DEMIANOWICZ-HLYN, 1960). The weight of the nectar gained from the flowers was measured on torsion and analytical scale. Then the dry-matter (%) of the nectar blown out from the capillaries was determined with a Zeiss-Abbé type refractometer. The mean values of the nectar-production of the flowers were defined from the data of the nectar gained from generally 100 (max. 250) flowers.

Results

During the course of the vegetation period the bee pasture-land of an area is comosed of the plants producing pollen and nectar. The species-spectrum of the meadow-plants and weeds serving as energy-source for the wild bees is broader than in the case of the honey-bees. From the viewpoint of wild apiculture energy-source, pollen and nectar production of the bee pasture-land are better utilized compared to the honey-bees. During the course of the 12 years' study series the flowering plants and weeds meaning food source for the wild bees were mapped according to sections at the bee pasture-land. Table 1. demonstrates the relative pollen- and nectar-production as well as the end values of the flower coverage in the course of the aspects.

Table 1. Foster-plants for the wild bees in the terrestrial ecosystem of the Tisza–river.

(1) Foster-plants for the *Apoidea* insect populations at the dam and flood area of the Lower–Tisza reach

Taxon	N Sp.	N S.	N A. aspect	P Sp.	P S.	P A. aspect	F.c		
Consolida orientalis (GAY)	–	1	–	–	1	–	1	–	6
Clematis integrifolia L.				–	1	–			
Ranunculus repens L.	–	1	–	–	1	–	5	–	24
Ranunculus acris L.	–	1	–	–	1	–	1	–	10
Thalictrum flavum L.				–	1	–			
Rubus caesius L.	2	3	–	–	1	–	2	–	15
Potentilla anserina L.	1	–	–	2	1	1			
Potentilla reptans L.	1	–	–	2	–	–			
Sedum acre L.	1	–	–	1	–	–			
Medicago lupulina L.	1	2	1	1	1	1			
Medicago sativa L.	2	3	2	1	1	1	1	–	13
Medicago rigidula (L.)									
Melilotus officinalis LAM.	3	3	2	1	1	1	4	–	5
Trifolium aureum POLLICH	–	2	–	–	1	–			
Trifolium campestre SCHREB.	1	1	1	1	1	1	3	–	7
Trifolium hybridum L.	–	1	–	–	1	–			
Trifolium pratense L.	1	2	1	1	1	1	3	–	35
Trifolium repens L.	1	2	1	1	1	1	1	–	70
Tetragonolobus siliquosus (L.)	1	2	–	1	1	–			
Lotus corniculatus L.	1	2	2	1	1	1	1	–	22
Astragalus onobrychis L.									
Glycyrrhiza echinata L.	–	2	–				1	–	27
Coronilla varia L.				–	2	–	1	–	54
Onobrychis vicifolia SCOP.	3	1	–	1	1	–			
Vicia faba L.	1	2	–	1	1	–	3	–	9
Vicia tetrasperma (L.)	2	–	–	1	–	–	3	–	5
Vicia biennis L.									
Vicia villosa ROTH	–	1	–	–	1	–	12	–	20

Taxon	N Sp.	N S.	N A. aspect	P Sp.	P S.	P A. aspect	F.c		
Vicia cracca L.	–	2	–	–	1	–	1	–	70
Vicia lathyroides L.	1	2	–	1	1	–			
Vicia angustifolia GRUFB.	–	1	–	1	–	–	20	–	25
Lathyrus tuberosus L.	1	1	–	1	1	–	1	–	15
Lythrum virgatum L.	–	1	–	–	1	–	3	–	45
Lythrum salicaria L.	–	2	2	–	1	1	1	–	55
Oenothera biennis L.									
Eryngium campestre L.				–	1	–	2	–	45
Eryngium planum L.	–	1	1	–	1	1	2	–	23
Pastinaca sativa L.				–	1	–	1	–	15
Daucus carota L.	1	1	–	1	1	–	1	–	20
Dipsacus laciniatus L.	–	1	–	–	1	–	1	–	3
Knautia arvensis (L.)	1	1	–	1	1	–	2	–	6
Scabiosa ochroleuca L.				–	2	–	1	–	12
Altheae officinalis L.	–	1	–	–	2	–	2	–	18
Malva silvestris L.	–	1	–	–	1	1	8	–	15
Euphorbia lucida W. et K.	–	2	–				3	–	25
Euphorbia salicifolia HOST.	1	1	–	1	1	–	1	–	5
Asclepias syriaca L.	–	2	–	–	1	–	30	–	80
Convolvulus arvensis L.	–	1	–	–	1	–	1	–	40
Calystaegia sepium (L.)	2	–	–	1	–	–	1	–	3
Symphytum officinale L.	1	2	1	1	1	1	1	–	50
Anchusa officinalis L.									
Echium vulgare L.	–	3	2	–	1	1	8	–	10
Teucrium scordium L.	–	1	–	–	1	–			
Glechoma hederaceae L.	2	–	–	1	–	–	5	–	8
Prunella vulgaris L.	2	2	–	1	1	1	2	–	9
Lamium amplexicaule L.	1	–	–	1	–	–	1	–	13
Lamium purpureum L.	2	2	–	1	1	–	5	–	35
Ballota nigra L.	–	3	1	–	1	1	5	–	15
Stachys annua L.	–	2	1	–	1	1	1	–	9
Stachys palustris L.	–	1	1	–	1	–	3	–	10
Salvia nemorosa L.	1	3	–	1	1	–	2	–	50
Mentha aquatica L.	–	2	1	–	1	1	3	–	10
Mentha pulegium L.	–	3	2	–	1	1	5	–	15
Mentha verticillata L.	–	2	2	–	1	1			
Verbascum phlomoides L.				–	1	–	1	–	2
Linaria vulgaris MILL.	–	2	1	–	1	–	1	–	6
Plantago lanceolata L.				–	1	–	2	–	3
Papaver rhoeas L.				1	–	–	2	–	14
Brassica napus L.							2	–	5
Capsella bursa pastoris (L.)	1	1	–	1	1	1	2	–	17
Lepidium draba L.	1	1	–	1	1	–	5	–	80
Rorippa silvestris (L.)	1	1	1	1	2	1	2	–	9
Rorippa ausriaca (CR.)	–	1	–	–	1	1			
Bellis perennis L.							1	–	3
Stenactis annua (L.)	–	1	–	–	1	2	4	–	8
Stenactis strigosa (MÜHLENB.)			–	1	1	2	–	30	
Erigeron canadensis L.				–	1	–	2	–	22

Taxon	N Sp.	S.	A. aspect	P Sp.	S.	A. aspect	F.c		
Inula britannica L.	–	1	1	–	2	2	2	–	40
Xanthium italicum MOR.							4	–	15
Achillea millefolium L.				–	1	1	1	–	27
Matricaria chamomilla L.				1	1	–			
Matricaria inodora (L.)	–	1	–	2	2	–	1	–	16
Chrysanthemum vulgare (L.)				–	2	1	8	–	25
Senecio vulgaris L.							1	–	10
Arctium lappa L.	–	2	1	–	1	1	5	–	30
Carduus nutans	–	2	1	–	1	1			
Carduus acanthoides L.	–	2	1	–	1	1	4	–	75
Cirsium arvense (L.)	1	3	1	1	1	1	5	–	20
Cirsium canum (L.)	–	2	–	–	1	–			
Centaurea pannonica (HEUFF.)	–	2	–	–	1	1	5	–	35
Cichorium intybus L.	–	2	1	–	1	1	1	–	12
Leontodon automnalis L.				–	1	1	2	–	4
Taraxacum officinale F. WEBER	3	–	–	2	–	–	2	–	6
Crepis rhoeadifolia M.B.	–	1	1	–	2	1	5	–	17
Hieracium caespitum DUM.									
Silene vulgaris (MONCH.)				–	1	1	1	–	17
Melandrium album (MILL.)	–	1	–	–	1	–	1	–	7
Chenopodium album L.				–	1	–	1	–	3
Lysimachia nummularia L.				–	1	–			
Lysimachia vulgaris L.	–	1	–	1	1	–			
Salix triandra L.	2	–	–	1	–	–			
Salix caprea L.	3	–	–	1	–	–			
Gagea lutea (L.)	1	–	–	1	–	–	2	–	15
Ornithogallum umbellatum L.	1	–	–	1	–	–	1	–	2
Iris pseudacorus L.	1	1	–	1	–	–			

(2) Foster-plants for the *Apoidea* insect populations at the dam and flood area of the Middle–Tisza reach

Taxon	N Sp.	S.	A. aspect	P Sp.	S.	A. aspect	F.c		
Consolida orientalis (GAY)	–	1	–	–	1	–	1	–	7
Consolida regalis S. F. GRAY							2	–	3
Clematis integrifolia L.				–	1	–			
Ranunculus repens L.	–	1	–	–	1	–	1	–	5
Ranunculus acris L.	–	1	–	–	1	–	1	–	8
Thalictrum flavum L.				–	1	–			
Rubus caesius L.	2	3	–	–	1	–	2	–	16
Potentilla anserina L.	1	–	–	2	–	–			
Potentilla reptans L.	1	–	–	2	–	–			
Medicago lupulina L.	1	2	1	1	1	1	1	–	4
Medicago sativa L.	2	3	2	1	1	1	1	–	70

Taxon	N Sp.	N S.	N A. aspect	P Sp.	P S.	P A. aspect	F.c		
Medicago rigidula (L.)							1	–	2
Melilotus officinalis LAM.	3	3	2	–	1	1	2	–	7
Trifolium aureum POLLICH	–	2	–	–	1	–			
Trifolium campestre SCHREB.	1	1	1	1	1	1	3	–	5
Trifolium hybridum L.	–	1	–	–	1	–			
Trifolium pratense L.	1	2	1	1	1	1	1	–	30
Trifolium repens L.	1	2	1	1	1	1	2	–	15
Tetragonolobus siliquosus (L.)	1	2	–	1	1	–			
Lotus corniculatus L.	1	2	2	1	1	1	1	–	45
Astralagus onobrychis L.									
Glycyrrhiza echinata L.	–	2	–				5	–	7
Coronilla varia L.				–	2	–	1	–	4
Onobrychis viciifolia SCOP.	3	1	–	1	1	–			
Vicia faba L.	1	2	–	1	1	–	3	–	5
Vicia tetrasperma (L.)	2	–	–	1	–	–			
Vicia biennis L.									
Vicia villosa ROTH	–	1	–	–	1	–	1	–	20
Vicia cracca L.	–	2	–	–	1	–	1	–	6
Vicia lathyroides L.	1	2	–	1	1	–			
Vicia angustifolia GRUFBA.	–	1	–	1	–	–			
Lathyrus tuberosus L.	1	1	–	1	1	–	1	–	14
Lythrum virgatum L.	–	1	–	–	1	–	1	–	7
Lythrum salicaria L.	–	2	2	–	1	1	3	–	4
Oenothera biennis L.									
Eryngium campestre L.				–	1	–	3	–	15
Eryngium planum L.	–	1	1	–	1	1	3	–	10
Pastinaca sativa				–	1	–	3	–	35
Daucus carota L.	1	1	–	1	1	–	1	–	55
Dipsacus laciniatus L.	–	1	–	–	1	–	1	–	5
Knautia arvensis (L.)	1	1	–	1	1	1			
Scabiosa ochroleuca L.				–	2	1	2	–	18
Althaea officinalis L.	–	1	–	–	2	–	4	–	5
Malva silvestris L.	–	1	–	–	1	1	2	–	6
Euphorbia lucida W. et K.	–	2	–				1	–	3
Euphorbia salicifolia HOST.	1	1	–	1	1	–	4	–	6
Asclepias syriaca L.	–	2	–	–	1	–	2	–	15
Convolvulus arvensis L.	–	1	–	–	1	–	1	–	20
Calystagia sepium (L.)	2	–	–	1	–	–	2	–	6
Symphytum officinale L.	1	2	1	1	1	1	3	–	28
Anchusa officinalis L.									
Echium vulgare L.	–	3	2	–	1	1	2	–	18
Teucrium scordium L.	–	1	–	–	1	–			
Glechoma hederacea L.	2	–	–	1	–	–	2	–	5
Prunella vulgaris L.	2	2	–	1	1	1	4	–	12
Lamium amplexicaule L.	1	–	–	1	–	–	1	–	10
Lamium purpureum L.	2	2	–	1	1	–	2	–	15
Ballota nigra L.	–	3	1	–	1	1	5	–	25
Stachys annua L.	–	2	1	–	1	1	2	–	5

Taxon	N Sp.	N S.	N A. aspect	P Sp.	P S.	P A. aspect	F.c		
Stachys palustris L.	–	1	1	–	1	–	5	–	25
Salvia nemorosa L.	1	3	–	1	1	–	1	–	3
Mentha aquatica L.	–	2	1	–	1	1	5	–	60
Mentha pulegium L.	–	3	2	–	1	1	1	–	25
Mentha verticillata L.	–	2	2	–	1	1			
Verbascum phlomoides L.				–	1	–	2	–	4
Linaria vulagaris MILL.	–	2	1	–	1	–	1	–	7
Plantago lanceolata L.				–	1	–	1	–	5
Papaver rhoeas L.				1	–	–	1	–	6
Brassica napus L.							6	–	8
Lepidium draba L.	1	1	–	1	1	–	2	–	30
Capsella bursa-pastoris (L.)	1	1	–	1	1	1			
Rorippa silvestris (L.)	1	1	1	1	2	1	2	–	25
Rorippa austriaca (CR.)	–	1	–	–	1	1			
Bellis perennis L.									
Stenactis annua L.	–	–	1	–	1	2	3	–	8
Stenactis strigosa (MÜHLENB.)							5	–	7
Erigeron canadensis L.				–	1	–			
Inula britannica L.	–	1	1	–	2	2	1	–	15
Xanthium italicum MOR.							2	–	25
Achillea millefolium L.				–	1	1	4	–	6
Matricaria chamomilla L.				1	1	–			
Matricaria inodora (L.)	–	1	–	2	2	–	1	–	15
Chrysanthemum vulgare (L.)				–	2	1	12	–	25
Senecio vulgaris L.							1	–	5
Arctium lappa L.	–	2	1	–	1	1	3	–	8
Carduus nutans L.	–	2	1	–	1	1	4	–	20
Carduus acanthoides L.	–	2	1	–	1	1	1	–	85
Cirsium arvense (L.)	1	3	1	1	1	1	1	–	6
Cirsium canum (L.)	–	2	–	–	1	–			
Centarurea pannonica HEUFF.	–	2	–	–	1	1	1	–	5
Cichorium intybus L.	–	2	1	–	1	1	1	–	25
Leontodon autumnalis L.				–	1	1	4	–	15
Taraxacum officinale F. WEBER	3	–	–	2	–	–	1	–	5
Crepis rhoeadifolia M. B.	–	1	1	–	2	1	2	–	13
Silene vulgaris (MÖNCH.)				–	1	1	10	–	50
Melandrium album (MILL.)	–	1	–	–	1	–	1	–	3
Chenopodium album L.				–	1	–	2	–	4
Lysimachia nummularia L.				–	1	–			
Lysimachia vulgaris L.	–	1	–	1	1	–			
Salix triandra L.	2	–	–	1	–	–			
Salix caprea L.	3	–	–	1	–	–			
Gagea lutea (L.)	1	–	–	1	–	–	1	–	35
Ornithogallum umbellatum L.	1	–	–	1	–	–	1	–	3
Iris pseudacorus L.	1	1	–	1	1	–			

(3) Foster-plants for the *Apoidea* insect populations at the dam and flood area of the Upper-Tisza reach

Taxon	N Sp.	S.	A. aspect	P Sp.	S.	A. aspect	F.c		
Ranunculus repens L.	–	1	–	–	1	–	1	–	2
Ranunculus acris L.	–	1	–	–	1	–	1	–	4
Rubus caesius L.	2	3	–	–	1	–	5	–	23
Potentilla anserina L.	1	–	–	2	1	1			
Potentilla reptans L.	1	–	–	2	–	–			
Medicago lupulina L.	1	2	1	1	1	1			
Medicago sativa L.	2	3	2	1	1	1			
Medicago rigidula (L.)									
Melilotus officinalis LAM.	3	3	2	1	1	1	2	–	4
Trifolium aureum POLLICH	–	2	–	–	1	–			
Trifolium campestre SCHREB.	1	1	1	1	1	1	3	–	4
Trifolium hybridum L.	–	1	–	–	1	–			
Trifolium pratense L.	1	2	1	1	1	1	1	–	16
Trifolium repens L.	1	2	1	1	1	1	3	–	30
Lotus corniculatus L.	1	2	2	1	1	1	1	–	15
Glycyrhizza echinata L.	–	2	–				4	–	12
Coronilla varia L.				–	2	–	3	–	5
Vicia tetrasperma (L.)	2	–	–	1	–	–			
Vicia villosa ROTH	–	1	–	–	1	–			
Vicia cracca L.	–	2	–	–	1	–	3	–	14
Vicia lathyroides L.	1	2	–	1	1	–			
Vicia angustifolia GRUFB.	–	1	–	1	–	–			
Lathyrus tuberosus L.	1	1	–	1	1	–	3	–	8
Lythrum virgatum L.	–	1	–	–	1	–			
Lythrum salicaria	–	2	2	–	1	1	4	–	5
Eryngium planum L.	–	1	1	–	1	1			
Pastinaca sativa L.				–	1	–	2	–	12
Daucus carota L.	1	1	–	1	1	–	2	–	17
Knautia arvensis (L.)	1	1	–	1	1	–	1	–	35
Scabiosa ochroleuca L.				–	2	–	3	–	22
Althaea officinalis L.	–	1	–	–	2	–			
Malva silvestris L.	–	1	–	–	1	1			
Euphorbia lucida W. et K.	–	2	–				3	–	15
Euphorbia salicifolia HOST.	1	1	–	1	1	–	2	–	3
Convolvulus arvensis L.	–	1	–	–	1	–	1	–	5
Calystegia sepium (L.)	2	–	–	1	–	–			
Symphytum officinale L.	1	2	1	1	1	1	1	–	6
Echium vulgare L.	–	3	2	–	1	1	2	–	8
Glechoma hederacea L.	2	–	–	1	–	–	3	–	6
Prunella vulgaris L.	2	2	–	1	1	1	3	–	9
Lamium purpureum L.	2	2	–	1	1	–	1	–	15
Ballota nigra L.	–	3	1	–	1	1	10	–	20
Stachys annua L.	–	2	1	–	1	1			
Stachys palustris L.	–	1	1	–	1	–	1	–	6
Salvia nemorosa L.	1	3	–	1	1	–	5	–	7
Mentha aquatica L.	–	2	1	–	1	1			
Mentha pulegium L.	–	3	2	–	1	1	1	–	6

Taxon	N Sp.	N S.	N A.	P Sp.	P S.	P A.	F.c		
	aspect			aspect					
Mentha verticillata L.	–	2	2	–	1	1			
Verbascum phlomoides L.				–	1	–			
Linaria vulgaris MILL.	–	2	–	–	1	–	1	–	4
Plantago lanceolata L.				–	1	–			
Papaver rhoeas L.				1	–	–			
Lepidium draba L.	1	1	–	1	1	–	1	–	20
Capsella bursa-pastoris L.	1	1	–	1	1	1	1	–	5
Rorippa silvestris (L.)	1	1	1	1	2	1	1	–	5
Rorippa austriaca (CR.)	–	1	–	–	1	1			
Bellis perennis L.									
Stenactis annua (L.)	–	–	1	–	1	2			
Stenactis strigosa (MÜHLENB.)				–	1	1			
Erigeron canadensis L.				–	1	–	2	–	18
Inula britannica L.	–	1	1	–	2	2	2	–	9
Xanthium italicum MOR.									
Achillea millefolium L.				–	1	1	2	–	15
Matricaria chamomilla L.				–	1	1			
Matricaria inodora (L.).	1	1	–	2	2	–	2	–	30
Chrysanthemum vulgare (L.)				–	2	1	6	–	7
Senecio vulgaris L.							1	–	20
Arctium lappa L.	–	2	1	–	1	1	4	–	15
Carduus acanthoides L.	–	2	1	–	1	1	5	–	15
Cirsium arvense (L.)	1	3	1	1	1	1	3	–	5
Cirsium canum (L.)	–	2	–	–	1	–			
Centaurea pannonica (HEUFF.)	–	2	–	–	1	1	2	–	26
Cichorium intybus L.	–	2	1	–	1	1	3	–	5
Leontodon autumnalis L.				–	1	1	2	–	8
Taraxacum officinale F. WEBER	3	–	–	2	–	–	1	–	6
Crepis rhoeadifolia M. B.	–	1	1	–	2	1	1	–	7
Silene vulgaris (MÖNCH.)				–	1	1	2	–	23
Melandrium album (MILL.)	–	1	–	–	1	–	1	–	8
Lysimachia vulgaris L.	–	1	–	1	1	–			
Salix triandra L.	2	–	–	1	–	–			
Salix caprea L.	3	–	–	1	–	–			
Gagea lutea (L.)	1	–	–	1	–	–	1	–	10
Ornithogallum umbellatum L.	1	–	–	1	–	–	1	–	2

Abbreviations:
N = nectar
P = pollen
Sp = Spring aspect
S = Summer aspect
A = Autumn aspect
1. 2. 3. = Relative ratios of the pollen and nectar-production
F.c = Percentage of flower coverage

1. THE IMPORTANT FOSTER-PLANTS OF THE TERRESTRIAL BIOTOPES AT THE LOWER-TISZA REACH

Among the willows the *Salix triandra* forms a flowering set throughout spring. At Körtvélyes island and the Alpár meadow it flowers in April–May and produces pollen and nectar. It is firstly favoured by the *Andrena* species. The willows are in genaral the ligneous plants of the flood- meadow areas, producing the important spring pollen and nectar (HALMÁGYI and KERESZTESI, 1985). The *Lamium purpureum* and *Lamium amplexicaule* are also plants of the flood-area, producing exposed pollen and nectar. They are significant honey-makers (GULYÁS, 1968), however, owing to their long corollate tube, only the long-tongued *Osmia*, *Hoplitis*, *Eucera* and *Anthophora* species with more developed mouth organ are able to suck nectar from them. The *Glechoma hederaceae* is a plant flowering only in spring. The opinions are divergent regarding the nectar-production of this species. It is favoured by the long-tongued wild bee species. The *Potentilla anserina*, *Potentilla reptans* firstly produce pollen, but nectar as well in smaller degree. They are visited by the small-bodied *Halictus* and *Lasioglossum* species. In April–May the *Taraxacum officinale* is one of the most important nectar- and pollen-producing plants at the grass-slope. The individuals of the *Andrena*, *Halictus*, *Lasioglossum*, *Bombus*, *Megabombus*, *Pyrobombus* species collect from its flowers. In the case of the *Compositae* species the abundant nectar production is the result of the joint secretion of the many flowers (PESTI, 1980). The *Lepidium draba* flowers with great coverage at the slopes of dam at the end of Spring in May and June, with a percental value between 5–80. It was particularly favoured by the bumble-bees, but the other wild bees species also visited it in large numbers. Its nectar is easily approachable by the wild bee species with shorter mouth organs, too. The *Vicia* species are also good honey-makers at the end of spring, however, with the exception of the extrafloral nectarians, only few taxa are capable of sucking nectar from the flower apart from the species of the *Osmia*, *Hoplitis*, *Eucera* and *Anthophora* genera, due to the long corollate tube. Prior to the first mowing the *Vicia cracca* also flowers in large numbers at the flood areas, at places even reaching a coverage of 70%. According to our experiences the *Osmia*, *Eucera* and *Anthophora* species of short swarming period in spring and with long mouth organs have adapted to the long corollate tubed labiate flowers, as well as to a few papilionaceae during the course of the coevolution. The *Salvia nemorosa* flowers in great numbers at the end of spring. Its coverage even reached 50% at certain places. It is a good honey-making plant (GULYÁS, 1968). The *Convulvulus arvensis* even reached a coverage of 40% on occassions at the end of spring, mainly at the top of the dam. It firstly provides pollen for the species of the *Systropha*, *Halictus*, *Lasioglossum* genera. At the end of the spring aspect the *Capsella bursa-pastoris* and the *Rorippa silvestris* produce pollen and nectar. These are firstly favoured by the male *Andrena* individuals.

The mass flowering of the *Lotus corniculatus* is at the beginning of summer. It is an abundant nectar-source for the species of the *Chalicodoma*, *Megachile*, *Andrena*, *Bombus*, *Megabombus* genera, but its pollen-production is also significant. The *Lotus*

corniculatus maintains itself even for 15–20 years in the mixture of pasture and meadow, by means of its own seed rotation (SAS, 1956). In summer the *Coronilla varia* even reaches a coverage of 55% occassionally, in patches. Owing to its abundant pollen-production, the agriculturally also valuable *Andrena ovatula* and *Andrena labialis* species prefer this plant. In June–July the *Lathyrus tuberosus* is favoured by the species of the *Chalicodoma*, *Megachile*, *Andrena* genera. Following the subsidence of the spring inundations this plant sometimes even flowers with a coverage of 15% at the inner side of the slopes of dam covered with water and on the alluvial soil of the flood areas. The *Symphytum officinale* is preferably significant at the water-side slope of dam and the flood area, firstly giving nectar; and pollen to a smaller extent. At the surveyed area the average daily nectar-production of a flower was 12.3 mg, its sugar percentage was 25, and the sugar value 3.16 mg. This proved to be the most valuable foster-plant during the course of the measured nectar-production studies (Table 2). HALMÁGYI and SUHAJDA (1963) studied the honey-making of the *Symphytum officinale* at the Southern Danube flood area. There the nectar production showed values between 2.0–4.9, and the sugar value 0.7–1.1 mg. However, the values measured by the authors proved to be higher close to the Tisza. Its flower coverage is high at places (50%), blooming continuously and being one of the best food-sources for the wild bee populations during the course of vegetation. At the end of spring, beginning of summer it was favoured

Table 2. Nectar-production of the studied species

Name	No. of flowers	Nectar		
		mg/24h	sugar %	sugar value 24h/sugar/mg
Salvia nemorosa	493	6.09	36.05	2.19
Lotus corniculatus	52	4.50	24.25	1.09
Lathyrus tuberosus	23	2.41	16.16	0.38
Medicago sativa	140	3.93	28.50	1.12
Trifolium pratense	135	4.18	33.62	1.40
Vicia villosa	84	1.70	21.62	0.36
Symphytum officinale	177	12.37	25.59	3.16
Lythrum virgatum	99	2.93	22.71	0.66
Echium vulgare	129	8.55	18.97	1.62

firstly for its nectar by the agriculturally also significant species of the *Andrena*, *Eucera*, *Melitta*, *Tetralonia*, *Bombus*, *Megabombus*, *Pyrobombus* genera. The *Salvia nemorosa* continuously blooms even during summer. The flowers collected from the study area showed average nectar-production of 6.0 mg, sugar percentage of 36.0 and sugar value of 2.1 mg. Besides the *Symphytum officinale*, this is the second most valuable foster-plant at the study area. At the flood areas and stagnant-watered meadows the *Lythrum salicaria* — at places with a coverage of 45% — is the primary foster-plant for the *Melitta nigricans*, *Melitta tricincta*, *Tetralonia nana*, *Tetralonia salicariae* and the *Tetralonia ruficornis*. It is considered to be an excellent nectar- and pollen-producing plant by NYÁRÁDI (1958).

The *Echium vulgare* is the drought-resistant plant of the Eastern, South–eastern slopes of dam giving abundant nectar and pollen in the middle of summer. It is an important foster-plant for the species of the *Bombus*, *Megabombus*, *Pyrobombus*, *Hoplitis* genera. At the surveying site at Tiszasziget one flower of the *Echium vulgare* produces an average of 8.55 mg nectar, with a sugar content of 18.9%. According to observations it was favoured in the greatest number by the honey-bees. On the basis of findings by DEMIANOWICZ (1953) it produces 250–300 kg honey at 1 ha in Poland. The flower coverage of the *Lythrum virgatum* is maximally 45%. It produces pollen and nectar, and favours the drier parts of flood areas of higher terraces. One flower produces 2.9 mg nectar, with a sugar percentage of 22.71. The composition of its flower-visiting insect population is similar to that of the *Lythrum salicariae*. In summer the flower of the *Vicia villosa* is the nectar and pollen source for the wild bee populations. It is firstly favoured by the species of the *Andrena*, *Anthidium*, *Paraanthidium* genera. The average nectar-production of a *Vicia villosa* flower is 1.7 mg, its sugar percentage is 21.6. This nectar-production is the lowest among the studied foster-plants. The *Vicia cracca* flowers in a shrub-like manner at the flood areas on the pioneer soils. Its coverage was maximally 70% in an area unit of 50 m^2. The vetch species are preferred by the species of the *Megachile*, *Chalicodoma*, *Andrena*, *Anthidium*, *Xylocopa*, *Bombus*, *Megabombus* genera, firstly for the purpose of nectar collection. The white clover blooms continuously in summer with great coverage (70%). According to observations by KOPELKIEVSZKIJ (1965), the blooming of the white clover lasts for about 90 days. BURMISZTROV (1959) measured the sugar-production of the *Trifolium repens* at meadow plantations and found it to be 8 kg per hectare. It is favoured for its nectar by the *Andrena ovatula*, *Andrena labialis* and *Andrena flavipes* species. The size of the pollen-collections is also significant in the case of the above mentioned species. The flowers of the *Trifolium repens* were firstly favoured by the hive bees at the surveying sites. In summer the *Medicago sativa* occurred with smaller, while the *Trifolium pratense* with higher coverage. The structure of their flower-visiting wild bee populations shows great overlapping. The humble-bees prefer the red clover for pollen. The wild bees collect nectar on the flower of the *Medicago sativa*.

The *Eryngium campestre* flowers with great coverage in the second half of summer at the protected side of the embankments. It is favoured in great numbers by the *Andrena variabilis*, firtsly collecting pollen from the flowers. The *Inula*

britannica is mostly liked for its pollen, as well as for nectar by the species of the *Tetralonia*, and *Melitta* genera in the second half of the summer. The *Carduus acanthoides* produces nectar and pollen, also in the second half of summer. Its flowers are favoured by the species of the *Halictus*, *Lasioglossum*, *Bombus*, *Pyrobombus* and *Megabombus* genera. The *Mentha aquatica* is also a good honey-maker, with a coverage of 10% at the stagnant-watered flood area meadows, following the subsidence of the inundations (GULYÁS, 1968). The *Cichorium intybus* blooms in the second half of summer, producing both nectar (PÉTER, 1973) and pollen. According to our studies, the *Halictus simplex*, *Halictus maculatus* and the *Andrena flavipes* firstly collected pollen on its flowers. Although being a good honey-maker, the *Cirsium arvense* (PÉTER, 1973) was only liked by few wild bee species. The *Crepis rhoeadifolia* was favoured by the *Halictus* and *Lasioglossum* species.

At the time of the autumn blooming aspect the number and degree of coverage of the flowering meadow-plants and weeds decreased from wild apicultural point of view. Only few flowers produce nectar by the middle of September. The flowering plants were mostly preferred by the wild bees pollen at this time. In the first half of September the *Lotus corniculatus* blooms alongside the L–T. reach, where it still produced nectar intensively (TANÁCS, 1979). The *Eryngium campestre* showed mass flowering frequently even till the middle of September, its pollen-production being significant for the *Andrena* species even at this time. At the beginning of autumn the most important foster-plants for the *Dasypoda* species are the *Knautia arvensis* and the *Scabiosa ochroleuca*. The flower of the latter plant was liked for pollen by the individuals of the *Dasypoda plumides*. From the viewpoint of the wild bees, one of the most important foster-plants in the autumn blooming aspect is the *Centaurea pannonica*. At Tiszasziget its coverage per area unit proved to be maximally 35%. It was favoured for pollen by the species of the *Halictus*, *Lasioglossum*, *Bombus*, *Megabombus* and *Psithyrus* genera.

2. THE MOST IMPORTANT FOSTER-PLANTS OF THE TERRESTRIAL BIOTOPES AT THE MIDDLE–TISZA REACH

In the biotopes near the catchment area the species-combination of the meadow-plants and weeds is more limited at certain areas, owing to the large surfaced red clover and lucerne resowing. At the bee pasture-land, the species number of the nectar- and pollen-producing plants was 104. At the flood area, prior to the banking up, the pollen- and nectar-production of the *Potentilla anserina* and *Potentilla reptans* provides food for the small-bodied wild bee species, like the individuals of the *Lasioglossum* genus, during the spring aspect. Following the establishment of the dam-system the coverage of the *Salix triandra* and other willow species is not significant during the spring aspect. At the flood area, in 1976–1977, the spring labiates, like the *Glechoma hederaceae*, *Lamium purpureum*, *Lamium amplexicaule* and *Prunella vulgaris*, had significant coverage. The *Prunella vulgaris* is also a good honey-maker (GULYÁS, 1968), even capable of producing 175 kg of honey per hectare. The *Vicia lathyroides*, *Vicia villosa* (20%), *Vicia cracca* (5%) and *Vicia*

angustifolia flower alongside the catchment area at the end of May and beginning of June. The coverage of the *Lepidium draba* during the course of the recordings alongside the catchment area even reached 30%, thus proving to be the most significant foster-plant of the spring aspect. The resowing of the various kinds of clovers is characteristic in places at the newly established dams. The *Trifolium repens* blooms at the more humid parts. The flower of the white clover excretes nectar with a concentration of 40% and sugar value of 0.04% (BEUTLER and SCHÖNTAG, 1940). DEMIANOWICZ (1953) refers to the fact that 1 ha of white clover even gives 100 kg honey-production. KOPELKIEVSZKIJ (1954) reports on similar results. According to our observations the white clover is favoured by the *Andrena* species and rarely by the *Halictus*, *Lasioglossum*, *Bombus*, *Megabombus* individuals. At the beginning of summer the *Trifolium pratense* is also in mass bloom. One flower of the red clover collected from the fill slope showed an average nectar-production of 4.1 mg, a sugar percentage of 33.6 mg and a sugar content of 1.4 mg. Since it flowers in dense clusters, it exerts strong attractive effect on the agriculturally also significant wild bee species. The species of the *Andrena*, *Eucera*, *Bombus*, *Megabombus* and *Pyrobombus* genera were found in great masses on the red clover. It had already been demonstrated earlier that there is a positive correlation between the quality of the nectar and the bee density (KROPACOVA, 1960).

The other significant resown papilionaceous agroculture was the *Medicago sativa*. Its maximal coverage reached 70%. Its nectar-production proved to be less than that of the *Trifolium pratense* according to our studies. The composition of the flower-visiting wild bee populations of the lucerne is similar to that of the red clover. During the course of studies the *Melitta leporina* proved to be a significant lucerne-visiting wild bee. In the first half of summer the *Brassica napus* is frequent at the saved-side of the embankment. It was favoured by the species of the *Halictus*, *Lasioglossum*, *Andrena*, *Bombus*, *Megabombus* genera. According to our observations these collect both nectar and pollen. During the course of the Lotus corniculatus resowings significant coverage develops (45%). This plant is an important pollen- and nectar-source in the regions of Poroszló and Tiszanána, as well as at the higher parts of the flood area. At these areas the coverage of the *Daucus carota* is also considerable, even reaching 55%, however, it is not significant for the wild bees. It was favoured by the *Hylaeus* and *Halictus* species. In the case of the labiates the *Stachys annua*, at more humid areas the *Stachys palustris* mean significant pollen- and nectar-source for the humble bees. There is a large amount of nectar even in the withering flowers of the *Stachys* species (GULYÁS, 1968). The *Prunella vulgaris* produces honey during the course of summer. Its coverage was of 12% at the deeper parts of the flood area and water-side slopes of the dam. Compared to the area alongside the L–T. reach, the *Mentha aquatica* bloomed at an essentially larger area in the terrestrial biotopes of the M–T. reach, at the flood area meadows in the region of Poroszló and Tiszanána. Its coverage even reached a maximum of 60%. At the protected side the *Ballota nigra* favours the areas of higher part. Its greatest coverage was 25%. It was favoured by the humble bees in large numbers which firstly collected nectar from the flowers. During the course of its long-lasting blooming it is the

abundant nectar-producing plant of the late summer (GULYÁS, 1968). The *Lythrum salicaria* and the *Lythrum virgatum* flower at the flood areas and riverside from July. The coverage of the willow species is not considerable, however, the enrichment of the *Tetralonia ruficornis*, as well as the *Tetralonia salicariae*, *Tetralonia nana*, *Melitta tricincta* and *Melitta nigricans* is significant on the flowers of the *Lythrum* species in the second half of summer. The coverage of the *Symphytum officinale* is significant at this study area, too (38%), although being less than alongside the L–T. reach. The enrichment of the *Echium vulgare* was observable on the left side of the slope of the dam along the catchment area, in South, South–eastern direction on the protected side. At this Tisza reach the coverage of the *Inula britannica* is significant in the second half of summer, prior to banking up. In the summer of 1976 the *Carduus acanthoides* also had great coverage (85%) in the region of Tiszaszőlős and Tiszaderzs, as the consequence of the discontinuance of mowings. Its flowers were favoured by the species of the *Bombus*, *Megabombus*, *Pyrobombus*, *Halictus* and *Lasioglossum* genera. This plant species produces both nectar and pollen, and has strongly attractive effect, distracting the agriculturally significant *Halictus simplex* and *Lasioglossum malachurum* species from the agrocultures of the back areas. The flower of the *Crepis rhoeadifolia* is an important nectar source for the gracile bees at the end of summer. At this period the *Cichorium intybus* also shows considerable enrichment. The coverage of the *Scabiosa ochroleuca* is significant at the end of summer and beginning of autumn. It serves as a pollen-source for the *Dasypoda plumipes* at this area, too. The *Eryngium campestre* occurs at the Eastern, South–eastern fill slopes. Following second mowing the red clover only serves as a pollen-source for the *Andrena* species. The *Rorippa silvestris* is favoured by the *Andrena* species and a few *Lasioglossum* individuals at the end of summer, and beginning of autumn. From the middle of September the nectar secretion of the flowers is decreased, or has completely ceased (GULYÁS, 1968). The *Carduus nutans*, *Crepis rhoeadifolia* and *Cichorium intybus* are important as pollen-producing plants. The *Chrysanthemum vulgare* blooms on the water-side, everywhere along the bank in a zone of 1–2 km. It was favoured by the *Hylaeus*, *Colletes* and *Lasioglossum* species. In the second half of September it is by a great number of the parasite *Sphecodes* species. According to our experiences, the parasite species favour the flowers of the heavily-scented meadow-plants and weeds with great preference.

3. THE MOST IMPORTANT FOSTER-PLANTS OF THE TERRESTRIAL BIOTOPES AT THE UPPER–TISZA REACH

The species-combination of the flowery meadow-plants and weeds of the bee pasture-land is poorer than at the former areas. Here, 83 flowering plants serve as bee pasture-land for the wild bees. The *Rubus caesius* is important at the end of the spring aspect. The foster-plants for the wild bees at the flood areas at the end of spring are the *Potentilla* species. They only produce nectar in small quantities. They are mainly favoured for pollen by the small body-sized *Halictus* (= *Seladonia* subgenus) and *Lasioglossum* species. The *Lepidium draba* appears in great masses

at the slopes of dam in May. At Tokaj, in front of the settlement, the *Taraxacum officinale*, *Vicia* species, *Rorippa silvestris* and *Lepidium draba* proved to be the most significant foster-plants. In the 2. zone at Tokaj the exposed nectar- and pollen-producing species at the flood area are the *Lamium purpureum*, *Glechoma hederaceae* and the *Prunella vulgaris*. The flower of the *Knautia arvensis* blooms in masses at the slopes of the dam of the 2. zone at Tokaj. The *Andrena hattorfiana* collects pollen in masses alongside the U–T. reach, prior to the first mowing. According to our observations the *Andrena hattorfiana* flew in masses from the flowers of the *Knautia arvensis* located at the fill slopes in the region of Jánd–Gulács to the apple-orchards of the neighbouring back areas. The apple-blossom pollinating activity of the *Andrena* species has also been observed in Tirol by SCHRECK and SCHEDL (1979).

At the end of the spring aspect the flower of the *Rorippa silvestris* was favoured by the male individuals of the *Andrena carbonaria*, *Andrena chrysoscelles* and *Andrena ovatula*.

In the summer aspect, prior to the second mowing, the maximal coverage of the white clover was 30%. At the surveyed-site of the 1. zone at Tokaj the joint flower coverage of the *Lotus corniculatus*, *Trifolium pratense*, *Vicia cracca* and *Lathyrus tuberosus* significantly ensured the continuous pollen- and nectar-source for the wild bees. At Tokaj the flowers of the *Lythrum salicaria* and *Lythrum virgatum* were preferred by the *Melitta tricincta*, *Melitta nigricans* and the *Tetralonia nana*. During summer, the important foster-plant at the protected side is the good honey-making *Ballota nigra* with a coverage of 30%, and at the water-side the *Matricaria inodora* with a maximal coverage of 30%. In the 1. zone at Tokaj the *Chrysanthemum vulgare* is significant at the end of summer, along the bank. These resulted the enrichment of the species of the pollen-swallowing *Hylaeus* as well as the *Colletes* genera. The riverside plant of the 2. zone is the *Stachys palustris*. The species of the *Compositae* plant family play important role in the structure of the bee pasture-land from the second half of the summer. In the 1. zone at Tokaj, on the protected side the *Arctium lappa*, while at the slope of the dam between Jánd–Tarpa the *Carduus acanthoides* species form greater set. Nectar and pollen were collected on the flower of the *Centaurea pannonica* by a few species of the *Andrena limata*, the *Halictus* and the *Lasioglossum*. At Tokaj, as well as the section between Jánd–Tarpa, the flowers of the *Euphorbia lucida* were favoured by the *Hylaeus* species. In the 1. and 2. zones at Tokaj the enrichment of the *Inula britannica* was significant in places. The coverage of the *Knautia arvensis* and *Scabiosa ochroleuca* is greater than in the terrestrial biotopes alongside the L–T. and M–T. reaches.

In respect to the biotopes of the U–T. reach, it was firstly observed in the summer aspect that the xerophyta and mesoxerophyta flowery weeds had essentially smaller coverage than at the terrestrial biotopes alongside the L–T. or M–T. reaches. It follows from this that their significance also decreases at the bee pasture-land. This firstly relates to the *Salvia nemorosa*, *Eryngium campestre*, *Echium vulgare* and certain *Trifolium* as well as *Vicia* species. According to our experiences during the

course of the studies along the U–T. reach, the vegetation period is shorter, which can be explained by climatic reasons. The wild bee species with wide ecological valency have the highest ratio here in the evaluations per section.

The species combination of the foster-plants is limited in the autumn flowering aspect. At the flood areas the *Chrysanthemum vulgare*, while at the slopes of dam from the second half of September, only the pollen-producing *Carduus* species, the *Crepis rhoeadifolia*, *Cichorium intybus*, *Centaurea pannonica* form more important food source. The exceptions to this finding were the pollen- and scanty nectar-producing *Trifolium pratense* and *Medicago sativa* stands, resown at the different sections, and being before the 3. mowing.

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